IONOSPHERIC PROFILING AND TOMOGRAPHY WITH GPS/MET

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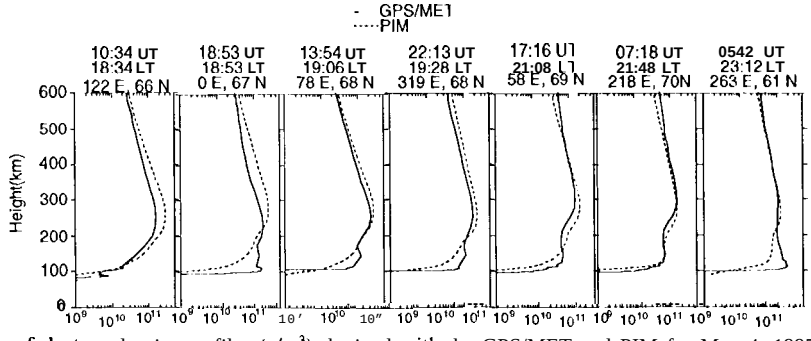
Tbc effects of the Earth's neutral atmosphere and ionosphere on signals of the Global Positioning System (GPS) present themselves as a source of error for navigation on tbc onc hand and a very effective means for studying the Earth's neutral atmosphere and ionosphere on the other hand. After reviewing the effects of the ionosphere on the GPS signal including group delay, bending and scintillation, wc will present how these effects are used to map electron densities and irregularities in the ionosphere. Particularly wc will talk about the GPS radio occultation technique and how it provides a powerful method for monitoring the ionosphere.

The idea of using radio occultations to sense the neutral atmosphere and the ionosphere was first used in planetary exploration, and has a heritage of about 30 years. As part of NASA's Mission To Planet Earth program, scientist at JPL (Yunck T. P. et al., Proc. of IEEE position location and navigation symposium, Orlando, 1988) proposed putting a receiver on a Low-Earth Orbiter to track GPS as it occults behind the ionosphere and neutral atmosphere. The bending induced by the atmosphere on the signal is detectable through tbc extra Doppler shift induced on the signal. Using a spherically symmetric model of the ionosphere in the locality of the occultation, a refractivity profile of the atmosphere can then be obtained from the bending information via an Abel integral transform. This concept was first realized with the launch of Microlab-I in March 1995 by the Orbital Sciences Corporation. This 730 km altitude, 70 deg. inclination satellite carries a flight qualified TurboRogue receiver developed at JPL and collects nearly 100 setting occultations per day. The experiment, known as GPS/MET and managed by the University Corporation for Atmospheric Research, has successfully demonstrated the usability of the GPS radio occultation signals to obtain accurate profiles of temperature in the upper troposphere and lower stratosphere. Profiles of electron densities arc also obtained in the ionosphere and are currently being examined to estimate their accuracy by comparing thcm to models such as the Parametrized ionospheric Model (PIM) and ionospheric images obtained from ionosondes and incoherent scatter radars.



Examples of electron density profiles (e/m^3) obtained with the GPS/MET and PIM for May 4, 1995. Indicated on the figure are geodetic latitude and longitude, universal time (UT) and local time (LT) for each occultation. The profiles arc ordered in increasing local time and they correspond to about the same latitude.

Our presentation will explain tbc radio occultation technique and show results from the GPS/MET experiment in the ionosphere. Wc will also present results on applying tomographic imaging techniques to the same data type and show 3-D images of electron densities and irregularities in the ionosphere.